

# THE MODULAR RECONFIGURABLE C4I INTERFACE - MRCI

**Dr. Judith Dahmann**

**Chief Scientist**

**and**

**Lt Col Mark Jefferson**

**Chief, Technology Applications Division**

**Defense Modeling and Simulation Office**

**1900 N. Beauregard St., Suite 504**

**Alexandria, VA 22311**

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## **ABSTRACT**

The ability to interoperate command, control, communications, computers, and intelligence (C4I) systems with simulation offers many potential advantages to the Department of Defense (DoD). Two of the primary advantages are the ability to (1) take modeling & simulation (M&S) to war, and to (2) train as you intend to fight. The interface between C4I and simulation will facilitate mission rehearsal; provide additional information to operational planners on weapons effects, sensor capabilities, etc.; provide additional insights/analysis regarding operational plans, potential dangers, conflicts, losses, and effectiveness; enhance distributed, collaborative planning among C4I systems; make it easier to use simulations for training users; and provide live C4I representations in simulation exercises. The result for the operational community is: *More effective planning, rehearsal, and operations equals more combat power!*

Toward facilitating use of the DoD High Level Architecture (HLA) to support interfaces between C4I systems and simulations, the Defense Modeling and Simulation Office (DMSO) has initiated the prototype development of the Modular Reconfigurable C4I Interface (MRCI). The MRCI would conceptually reside between the live C4I system and HLA runtime infrastructure (RTI) and be divided into three components: a section containing generic modules that transforms C4I information into information useable by simulations; an interface between the generic modules and the RTI; and a C4I system specific interface between the C4I system and the generic modules.

The MRCI initiative will produce two prototypes in the last quarter of FY96/first quarter of FY97.

## **INTRODUCTION**

The ability to interoperate command, control, communications, computers, and intelligence (C4I) systems with simulation offers many potential advantages to the Department of Defense (DoD). Two of the primary advantages are the ability to (1) take modeling & simulation (M&S) to war, and to (2) train as you intend to fight. The interface between C4I and simulation will facilitate mission rehearsal; provide additional information to operational planners on weapons effects, sensor capabilities, etc.; provide additional insights/analysis regarding operational plans, potential dangers, conflicts, losses, and effectiveness; enhance distributed, collaborative planning among C4I systems; make it easier to use simulations for training users; and provide live C4I representations in simulation exercises. The result for the operational community is: More effective

planning, rehearsal, and operations equals more combat power!

This last factor is not to be overlooked. Authoritatively representing the C4I process within simulation has become increasingly important, not only because it is a fundamental aspect of military operations, but because DoD leadership has come to regard it as a critical factor for achieving U.S. dominance in the Information Age. Whether it be examining the "sensor to shooter" linkage or exploring Information Warfare, one cannot do so without an authoritative representation of the C4I process. This is true not only during force-on-force engagements, but also during the planning process leading up to combat operations. The difficulty of modeling human cognitive processes, particularly for an area as immature and rapidly evolving as Information Warfare, makes it likely that DoD will

have to rely on humans-in-the-loop to examine such issues for some time to come.

Sub-Objective 1-1 of the DoD M&S Master Plan (signed by USD (A&T) on 17 Oct 95) directs establishment of a common high level architecture for simulation to facilitate the interoperability of all types of simulations among themselves and with real-world C4I systems. One of the actions associated with accomplishing this goal is to support linkages of M&S with C4I systems. C4I systems cannot afford to support different interfaces to different simulations. Common requirements across systems and simulations make reuse possible, and desirable from a cost perspective.

### **C4I TO SIMULATION FUNCTIONALITY**

C4I to simulation interfaces can be categorized into three major domains. As a stimulator, C4I systems would provide set-up information (i.e., plans, OOB, weather, etc) to simulations prior to execution. As a viewer, the C4I system would monitor the simulation's virtual world just as it monitors the real world. As a live player, the C4I system would be a dynamic participant with real people in a real environment iteratively taking/receiving actions effecting simulation outcome. The live C4I Player is logically the most demanding case.

The basic functionality that must exist in a C4I to simulation interface includes information exchange, ground truth exchange, and compliance with the DoD High Level Architecture (HLA) interface specification (I/F). Additionally, this functionality would need to include the ability to support/transfer control of an ongoing simulation should the C4I system drop off line. Examples of specific functionality might include: - Coordination of data transformations. - Message and datalink translation, building, and transmission. - Implementation of propagation effects. - Hardware acknowledgment. - Requirement for dead reckoning. - All five HLA runtime infrastructure (RTI) management functions. - Labeling of exercise messages/data. - Data collection output from at the C4I interface.

Developers will need to answer two crucial questions: "what does it mean to bring real world systems into the simulation world as equal participants", and "what are the technical requirements to make this integration occur."

### **HLA AND INTERFACES TO C4I SYSTEMS**

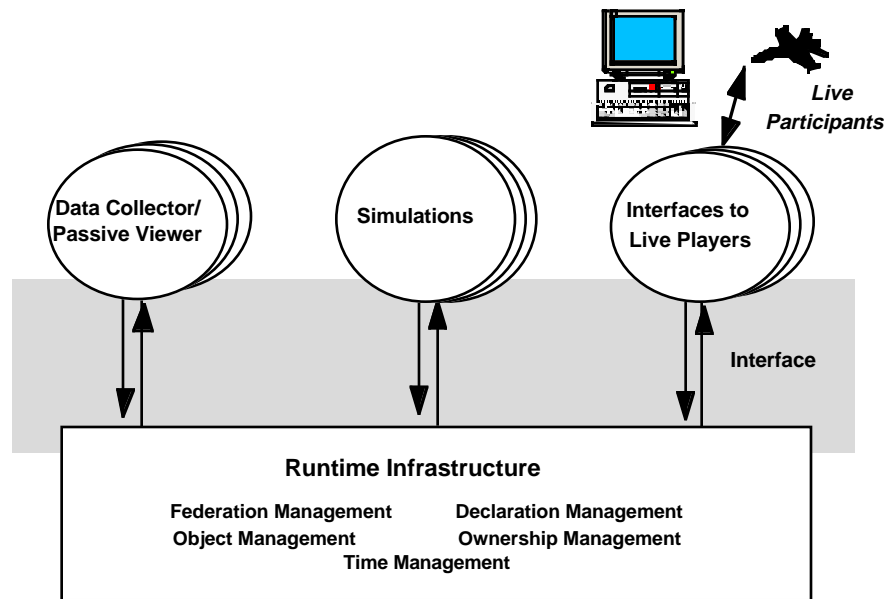
The HLA is being developed under the guidance of DMSO and the Architecture Management Group to provide the basic infrastructure for interoperability

among simulations, and among simulations and C4I systems. The HLA is depicted in figure 1.

As the figure indicates, the HLA has several major components. First are the simulations, or more generally, federates. All object representation is in the federates. The HLA imposes no constraints on what is represented in the federates or how it is represented. The HLA does require that all federates incorporate specified capabilities to allow the objects in the simulation to interact with objects in other simulations. Objects represented in one simulation interact with objects in other simulations through the exchange of data as specified in the federated object model. Second, interactions among the simulations go through the RTI. The RTI provides a set of services that support the simulations in carrying out these simulation to simulation interactions and federation management support functions. Third, the interface between the simulations and the RTI is specified as part of the HLA, and is common across simulations and federations.

Two other general capabilities of simulation systems are supported by the architecture. First, the HLA supports the passive collection of simulation data and monitoring of simulation activities. In the HLA, these tools act in the same way as simulations and interact with the RTI using the HLA interface.

Second, the HLA supports the incorporation of live participants, such as instrumented platforms or live command and control systems. Live participants interact with the rest of the simulated world through something that behaves like a simulation from the point of view of the HLA, that feeds a representation of the live world into the simulated world and that projects data from the simulated world back to the live system. This interface to live systems is the focus of efforts to support C4I to simulation interfaces.



**Figure 1. Functional View of the HLA**

## THE MRCI INITIATIVE

Toward facilitating use of the HLA to support interfaces between C4I systems and simulations, the Defense Modeling and Simulation Office (DMSO) has initiated the prototype development of the Modular Reconfigurable C4I Interface (MRCI). The MRCI would conceptually reside between the live C4I system and HLA RTI and be divided into three components: a section containing generic modules that transforms C4I information into information useable by simulations; an interface between the generic modules and the RTI; and a C4I system specific interface between the C4I system and the generic modules.

Although DMSO will resource and have policy oversight of this NRaD managed initiative, the intention is to work cooperatively with both the M&S and C4I communities. A goal of the initiative is to capture the best work done to date in the C4I to simulation interface arena and incorporate previous lessons learned. As such, four review teams (composed of representatives from the simulation programs, simulation centers, C4I systems, and previous C4I to simulation interface developers) have been established. The review teams will meet at key program milestones to insure the MRCI is being developed to meet warfighter, C4I system, and simulation program needs.

The MRCI initiative includes development of prototypes utilizing Air Force and Army C4I systems. The Air Force Contingency Theater Automated Planning System (CTAPS) systems will be linked to the Air Warfare Simulation - Re-

engineered (AWSIM/R) and Air Semi-automated Forces (SAF) via the MRCI; and the Army's Maneuver Control System/Phoenix (MCS/P) and Advanced Field Artillery Tactical Data Systems (AFATDS) systems will be linked to Corps Battle Simulation (CBS) and Ground SAF through the MRCI. In both cases, the MRCI interface to the large constructive simulations (i.e., AWSIM/R and CBS) may be in the context of the Aggregate Level Simulation Protocol (ALSP) Joint Training Confederation (JTC). The timeframe for the prototypes is last quarter FY96/first quarter FY97.

## CONCLUSION

The MRCI initiative will prototype a toolset that ties live C4I to simulation through the HLA. The MRCI will afford warfighters the opportunity to train on their current (and future) real-world C4I systems in a simulated environment. Additionally, the MRCI will be a reusable component supporting the M&S common technical framework. It is the objective of this effort to allow C4I systems of all types will be able to take advantage of the MRCI software thus avoiding bilateral interfaces from C4I to simulation. MARK L. JEFFERSON, Lt Col, USAF Chief, Technology Applications Division, DMSO 1-703-998-0660 (fax 0667) mjeffers@msis.dmsomil